REPORT ON SEA URCHIN STOCK ASSESSMENT WORKSHOP

JULY 14, 15 2006 HOLIDAY INN BAYSIDE, SAN DIEGO, CALIFORNIA

By

Dr. Ray Hilborn and Dr. Steve Schroeter

Attendance

Jenny Wolf (UCSB),Steve Schroeter (UCSB),Ray Hilborn (UW),Nicolas Gutierrez(UW),John Lynham(UCSB),Michael Robinson(UCSB),Chris Miller(CTLA),John Ugoretz(CDFG),Kristine Barsky(CDFG),Carrie Culver (CA Sea Grant),Jonathan Hardy(State Sen. Ducheny staff),Dave Rudie (San Diego Sea Urchin Processor & CSUC).San Diego sea urchin divers; Chris Sparks, Jerry Beverino, Kent Schellin, Dave Datz, Mike Neil, Susan Buck, Gary Harle, Peter Halmay.

Agenda

1. Review of data
2. Biological hypotheses
3. Model exploration
4. Process and role of Assessments
5. Objectives
6. Harvest strategies

Meeting Objectives

1. Review the role of stock assessment in a management process
2. Review data available for sea urchin assessments especially as related to the proposal "The San Diego Sea Urchin Fishery as a model for the expansion of the role of Fishermen/Managers in science-based management and value-added marketing" submitted to Ocean Protection Council.
3. Review objectives of a management plan and alternative harvest strategies
4. Determine where and how data will be assembled
5. Evaluate alternative types of assessments, and alternative biological assumptions that might be used in an assessment.
6. Identify issues needing to be resolved
7. Assign working tasks emerging from this meeting

Review of the role of stock assessment in the management process

Ray Hilborn provided an overview of the role of stock assessment, and how it relates to the management process. Steve Schroeter presented the status of the Barefoot protocol sampling design, and Nicolas Gutierrez provided an overview of ongoing work on an individual-based RSU population mode.

The purpose of a stock assessment is to evaluate the consequences of alternative management actions and normally includes estimation of current stock size, estimation of productive potential of the stock. Assessments may involve estimation of the history of stock abundance, productivity and exploitation.

Traditional types of stock assessment models include (1) Biomass dynamics models which track total abundance, (2) Size Structured models which track numbers at size using size

transition probability table, and size frequency data, and (3) Age structured models, which track numbers at age primarily fitting to observed age distribution.

Each of these kinds of stock assessments must have catch and some index of population abundance and assume that all changes in abundance result from catch interacting with the productivity of the stock. These methods can use other indicators such as size or age distribution, tagging, etc. when available, and may relate productivity to environmental factors such as food, predators or physical environmental variables, like temperature.

Differences between traditional fin-fish assessments and those for sedentary invertebrates are that invertebrate assessments are (1) often size structured rather than age structured, (2) the spatial scale of the "stock" is often much smaller, and (3) the link between "stock" and subsequent recruitment is less direct. This lack of stock-recruitment relationships is due to the fact that recruitment to stocks in small areas is usually driven by a much larger population so that the spawning stock abundance of a single managed stock has little impact on subsequent recruitment and the observation that for many invertebrates it appears that recruitment is limited more by habitat and environmental conditions rather than by spawning stock.

Review of data available for RSU and Pt. Loma assessments

Catch and removals data: We have red sea urchin catch data for the Pt. Loma kelp bed from 1974 onwards. Catch data from other areas in S. California are also available. We do not at present have any estimates in hand of RSU killed by quicklime in the 1966-1980 period.

A time series of index-of-abundance is problematic. There are no fishery-independent surveys; we might attempt to reconstruct a CPUE series, but this would be problematic because the fishermen are able to search for and find the concentrations of uni-bearing (i.e. gonads of requisite quality) urchins and we would not expect the CPUE to decline proportionally to abundance. It might be possible to assume that some constant high fraction of the uni-bearing urchins are harvested, but the dramatic changes in effort over the years, especially in the years following the 1983 El Nino make this assumption dubious. We discussed assuming that the faction of uni-bearing urchins harvested was some function of effort, and this appears to be the most reasonable starting assumption.

There is no data (fishery independent or fishery dependent) on the history of abundance of non uni-bearing red sea urchins, and as it seems that this is a critical portion of the population, we expect to have severe limits on the extent to which we can reconstruct the history of the total RSU population. Collection on current abundance of non uni-bearing red sea urchins both in fished areas and in unfished areas is a high priority.

All parties agreed that kelp abundance has a critical role in providing uni-bearing red sea urchins, and possibly in affecting recruitment, growth and survival. We do have some time series data on kelp abundance, but there are gaps. Further these data cover only the surface canopy kelp and don't include several other types of kelp (elk and palm kelp) that are thought to be very important in the dynamics of RSU.

Data gaps identified

A number of data gaps were identified that need filling in order to implement further modeling on stock assessment (Hilborn) and individual-based models of red sea urchin populations (Gutierrez). The following table describes these gaps and the people who are tentatively assigned to fill them.

Table 1. Summary of some data gaps and person(s) responsible for filling them

Description	**Tentative list of Person(s) responsible for filling gap**
Number of RSU killed by quicklime 1966-1980(Pt Loma and La Jolla)	Pete Halmay; John Duffy; Dale Glantz
Quantify abundance of sub surface kelps (elk, palm)	Steve Schroeter & Mike Robinson
Separate RSU harvests by kelp bed (i.e. 1,2,3,4 and North County)	Kristine Barsky & John Ugoretz assisted by Barefoot Ecologist tech
Obtain average price of RSU for San Diego for 1988-2006 by month	Dave Rudie
Using CDFG log books and receipts obtain CPUE (catch per diver day)	Kristine Barsky & John Ugoretz assisted by (certified) Barefoot Ecologist tech
Using CDFG log books obtain number of boats (La Jolla and Point. Loma over the threshold of over 20 landings or over 8000 lbs. in any year)	Kristine Barsky & John Ugoretz assisted by (certified) Barefoot Ecologist tech
Literature regarding RSU abundance and size distribution in San Diego (Segars, Kelco reports etc.)	Steve Schroeter & Dale Glantz
Develop assessment methodology using calibrated ROV surveys for deep water RSU.	Steve Schroeter & Donna Schroeder
Literature regarding bioenergetic parameters for sea urchin growth, mortality, and gonadal maturation	Steve Schroeter & Nicolas Gutierrez

Review objectives of a management plan and alternative harvest strategies

Discussed at the meeting were overall objectives of a management plan and a consideration of alternative harvest strategies. The RSU fishery is unusual in that the market is local for fresh uni, and thus a year round fishery is essential despite seasonal variation in uni content, and that the harvest is of uni, not sea urchins, so that it is the availability of uni-bearing urchins that is critical to the harvest. The following were identified as major objectives of participants.

1. Ecological sustainability
2. Year round supply
3. Economic viability of harvesting sector
4. Maintenance of local harvesting fleet

Determine where and how data will be assembled

See Work Tasks below.

Evaluate alternative types of assessments, and alternative biological assumptions that might be used in a red sea urchin stock assessment.

As a result of work performed during the workshop, it appears that we may be able to fit a model to the data to explain the history of abundance and removals of uni-bearing red sea urchins. However as the data collected so far in the barefoot-ecologist program suggest that most uni-bearing red sea urchins are recruiting into the fishery at reasonably large size, it is accepted that most of these individuals are non uni-bearing individuals who transform into the uni-bearing classes when feeding conditions are appropriate. As we have no data on the history of non uni-bearing red sea urchins this means we cannot attempt to estimate the history of recruitment to the whole population.

At best, therefore, with the addition of sampling outside commercially fished areas, and in deep water, we should be able to determine the abundance of both uni-bearing and non uni-bearing red sea urchins at present, and hopefully determine if there is a significant amount of spawning taking place outside of fished areas, from deeper urchins or more offshore urchins.

If we conclude that there is a significant amount of spawning taking place either outside fished areas, or by individuals below the size limit, then the assessment can concentrate on the dynamics of the uni-bearing red sea urchin population for yield purposes and assume that there are no concerns about recruitment overfishing.

If, however, it appears that the majority of spawning is coming from the fished population then an assessment model and harvest strategy will need to be designed to assure that sufficient spawning stock is protected to assure sustainability.

During the workshop some alternative model structures were discussed, and it seems likely that an appropriate model would include at least two pools of individuals, uni-bearing and non uni-bearing sea urchins, and that some classes of size/age would be useful.

It would seem appropriate to build assessment models under the two assumptions of (1) recruitment limited by harvested population and (2) recruitment not limited by harvested population.

A range of hypotheses regarding the role of kelp in maturation, recruitment and survival were discussed and would be included in assessment models.

Identify issues needing to be resolved

Assessment issues are discussed in the previous section. Data needs are discussed in the following section. The workshop discussed institutional changes needed to move the fishery from a competitive fishery where it is not in an individual divers' interest to leave urchins behind to increase their uni-content, to a non-competitive fishery where yields and quality could be increased. It is recognized that there are a range of ways this could be done including cooperatives, area based fishing privileges, and catch shares. These options were discussed, but the main focus of the workshop was stock assessment under the assumption that an effective stock assessment is necessary for evaluating the efficacy of alternate harvesting and management strategies.

Assignment of working tasks emerging from this meeting

Table 2. Working tasks and assignment of responsibility for implementing them

Task	Description	Responsible party and estimated time required
Methods of Assessment	Limited calibration work indicates that the Barefoot protocol may be more accurate than the CRANE (CDF&G) protocol for estimating densities and size distributions, but more calibration work needs to be done to see if this is the case. Specifically, the goal of calibration would be to see how biases vary with patchiness and density. This information will be used to tailor the Barefoot sampling design to minimize The data collected to date suggests that the problems of bias and accuracy could be overcome by collecting large numbers of samples with the Barefoot protocol. Estimates of density sufficiently precise to detect 10% changes in density from year to year could be gotten from 1000-1500 Barefoot samples per year. Given the past history of Barefoot data collection with a single diver, this is a very reasonable goal. Ongoing Barefoot Assessment in the short-term, must persuade at least two more divers in San Diego to begin.	Steve Schroeter & Pete Halmay August 2006-December 2006
Certification of Barefoot Ecologists	Certification" process to allow new divers to participate and will encourage participation	Ray Hilborn August 2006-October 2006

Table 2. (continued)

Task	Description	Responsible party and estimated time required
Permitting	Permit process to allow take of urchins for research off-season and outside size limits.	John Ugoretz & Peter Halmay August-September 2006
Characterizing urchin populations in non-kelp habitat (deep habitat offshore of historical harvest grounds)	Look at deep habitat and where deep urchins may exists. Determine the gonadal condition of urchins in these habitats and whether they are spawning. Determine size range and whether or how it differs from that in the historical harvest grounds (i.e. kelp habitat) Explore the use of ROVs and kelp baited traps to characterize size, age, and gonadal condition and thus proportion of uni-bearing RSU in the deeper populations.	John Ugoretz/Steve Schroeter/Donna Schroeter/Chris Miller Plan: September/October 2006; Field work: November 2006-November 2007
Assess Kelp persistence in La Jolla and Point Loma Kelp beds	Contact John Ugoretz and Dennis Bedford for the CDF&G kelp data. Contact Larry Deysher and Jan Svejkovsky (Ocean Imaging). Larry has created kelp canopy persistence maps using data from NPDES monitoring of the southern California Bight by Wheeler North & MBC's aerial overflights in region 9 (Orange & San Diego Counties). The Point Loma/La Jolla database goes back to 1967. This work should start with La Jolla, Point Loma, and Imperial Beach beds. These data should be combined with kelp biomass estimates compiled by Dale Glantz and available through the UCSB LTER program. Michael Robinson will help with GIS work	Dennis Bedford, John Ugoretz, Larry Deysher, Michael Robinson & Steve Schroeter August - October 2006
Track uni price time series	Track of price/per year by area (possibly done already, if not easy to do). Is price driving catch more than population? How does price drive effort?	Dave Rudie August-October 2006

Table 2 (continued

Task	**Description**	**Responsible party and estimated time required**
Track CPUE from logbooks	Catch Per Unit Effort from logbooks (moderately easy to do, need CDFG staff). How does CPUE change with time? How are CPUE and effort related?	Kristine Barsky/Pete Halmay, CDF& G & Barefoot technician August-October 2006
Barefoot Ecologists	Expand barefoot Ecologist program to Imperial beach, La Jolla and North San Diego County	Peter Halmay & existing Barefoot Ecologists September 2006 – September 2007
Characterize red sea urchin movements -I	At the kelp bed level determine how red sea urchins move based on information from divers with more than 20 years of experiential knowledge	San Diego Barefoot Ecologists/Nicolas Gutierrez/Steve Schroeter/Pete Halmay. September 2006
Characterize red sea urchin movements -II	Movement Study (new work, involve divers in experimental design and monitoring). Use a combination of trapping, mass-marking and time-lapse video cameras to assess movement rates both within the historic harvest grounds and between the historic grounds and hypothesized non-harvest ground (e.g. deep habitats) habitats. Properly designed this work would allow comparison of RSU movements as a function of depth, topography and food (giant kelp and understory kelps) availability. It could address the important questions such as: Is food limiting/enhancing movement? What other factors determine movement look at episodic nature of large movements (e.g. local topographic relief, storms, unusual changes in temperature	Nicolas Gutierrez/Ray Hilborn/Steve Schroeter/Pete Halmay. Design: August-October 2006. Implement October 2006 – October 2007

Table 2 (continued

Task	**Description**	**Responsible party and estimated time required**
Characterize red sea urchin movements –II (contd.)	As part of the movement study we will use data on known growth and mortality rates to filter out the effects of growth and mortality from movement. These data (along with data on the bioenergetics of growth, maturation and mortality) will be used to parameterize an individual based RSU population model.	Nicolas Gutierrez/Ray Hilborn/Steve Schroeter/Pete Halmay. Design: August-October 2006. Implement October 2006 – October 2007
Stock Assessment	Using all of the above, select the most appropriate scale and nature of assessment and conduct an assessment (COPC proposal from SDWA, appendix A)	Ray Hilborn December 2006-March 2007
Policy	How is leadership for institutional change in management developed to allow for innovative fishery tactics?	California Ocean protection Council/Rod Fujita